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THE REGENERATION OF A DOUBLE CHELA IN
THE FIDDLER CRAB (*GELASIMUS PUGI-*
LATOR) IN PLACE OF A NOR-
MAL SINGLE ONE.¹

CHARLES ZELENY.

The double chela described in the present paper was regenerated from the distal end of the stump of the smaller chela of a male fiddler crab (*Gelasimus pugilator*) after autotomy of that appendage at the breaking joint. The case seems of interest not only because it is a regeneration product but also because it belongs to the rare class of truly double appendages.

The crab which developed the double chela originally possessed a normal small chela on the right side and a normal large chela on the left and was operated on at Cold Spring Harbor on July 2, 1902.² The nerves of the two chelæ were injured by a needle, the injury in each case resulting in immediate autotomy of the appendage at the breaking joint. The crab was isolated and fed on *Mytilus* (horse-mussel). It moulted on August 4, 33 days after the operation. On both sides the regenerated chelæ were of considerable size and the right or smaller one was seen to be double. The crab was kept under observation for 17 days after the moult, or 50 days after the operation. Two views of the chela are given in the accompanying figure which shows the terminal four podomeres. The first,³ second and third podomeres are of the typical single form. The fourth podomere, however, is divided terminally so that there are two entirely separate indices (*I, I'*). The split extends well down into the body of the propodite on this side. In connection with each index there is a dactylopodite (*D, D'*). The split on the dactyl side of the propodite, though not as deep as on the index side, nevertheless

¹ "Contributions from the Zoölogical Laboratory of Indiana University," No. 67.

² The operation was performed as part of a series of experiments on compensatory regulation which are described in a paper now in press under the title of "Compensatory Regulation," *Journal of Experimental Zoölogy*, Vol. II., No. 1.

³ Not shown in the figure.

completely separates the two dactyls and forms a very distinct groove in the propodite.

One of the resultant pinchers (*DI*) the one more directly in the line of the axis of the chela is stouter than the other. In the stouter chela the dactyl and index are approximately of equal length. In the smaller chela (*D'I'*) the dactyl is very noticeably longer than the index. Except for these slight differences and the more slender character of the smaller chela it is a perfect mirror image of the other. As the split is deeper on the index than on the dactyl side, the dactylopodites are nearer together than are the indices. The planes of the two chelæ

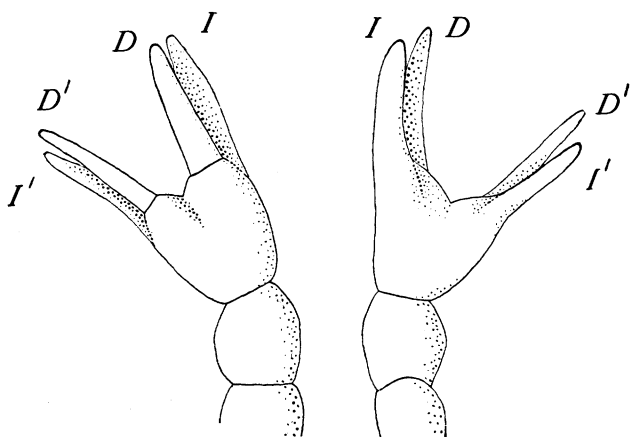


FIG. 1. Double chela of *Gelasimus pugilator* ($\times 12$). Left figure: viewed from pollex border. Right figure: viewed from index border.

therefore converge slightly on the dactyl side and diverge on the index side. In life both parts of the double chela functioned as pinchers.

DISCUSSION.

The double chela which has been described evidently comes under the group of true double appendages, a group the existence of which Bateson¹ was loath to admit since he considered the possibility that the supernumerary appendage in such cases is in reality itself double, as is true in a great number of the abnormal limbs so far described.

¹ Bateson, "Materials for the Study of Variation," 1894.

The nearest approach to the condition of the present double chela that I have been able to find in the literature is the right cutting chela of a female lobster figured by Herrick on p. 147, plate E, of his "American lobster." This gives a chela which is apparently truly double from the carpopodite out. The two parts resemble each other very closely.

In Bateson's list¹ Nos. 832 to 835 come under the same head. Of these No. 833 (Fig. 200 1, p. 542) described by Faxon² as a right chela of *Homarus americanus* shows two dactylopodites articulating separately. The index is bifid at its tip and has two rows of teeth, one on each edge. If the separation of the dactylopodites had been slightly greater than shown in Faxon's figure and the split in the index had extended slightly further down on its side than the split in the dactyl a fair representation of the condition in the *Gelasimus* chela would have resulted. A similar modification in the degree of the split would bring Nos. 832, 834 and 835 into the same category.

There can be no doubt that the present regenerated double chela is a true double appendage, one part being a mirror image of the other except for the slight differences given above. The relation of the parts is such as one would expect if after the regenerating bud of the chela had become specified a mechanical force had partly separated it into two nearly equal parts by a quantitative split, *i. e.*, one passing in the plane of the future chela. With but a slight rearrangement of the materials in the two parts each is supposed to have been able to form a complete pincher in a manner entirely similar to that in the constriction experiments of Spemann and others³ on Amphibian eggs by which double and partly double embryos were produced. The wider separation of the indices as compared with the dactyls is supposed to be due to the greater depth of the mechanical split on this side.

I have no suggestion to make as to the nature of the agency which caused the division of the embryonic mass. Spemann's

¹ *L. c.*, pp. 541, 542.

² Faxon, *Bull. of the Mus. of Comp. Zool. Harv.*, Vol. VIII., No. 13, 1881.

³ Spemann, Hans, "Entwicklungsphysiologische Studien am Triton-Ei," *Roux's Archiv*, Bd. XII., p. 224, 1901. Herlitzka, A., *Roux's Archiv*, Bd. II., pp. 352 ff. Endres, H., *Roux's Archiv*, Bd. II., pp. 517 ff.

experiments on the production of double embryos by constriction of Triton eggs by means of hairs and similar experiments of others as mentioned above, certainly indicate the possibility of producing double chelæ by similar methods used on the regenerating buds of Crustacean chelæ. Such experiments will be undertaken as soon as suitable material can be obtained.¹

If the explanation given turns out to be a true one it follows that the mass of embryonic cells which in the ordinary regenerating bud forms a single chela has because of the partial separation of its material been forced to develop a double one. Or stating the same facts in the convenient terms introduced by Driesch we may say that while the early regenerating bud has ordinarily a *prospective value* of a *single* chela the present case certainly shows that the same mass of cells has a *prospective potency* of *two* chelæ.

INDIANA UNIVERSITY,
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¹ Andrews, E. A. ("An Aberrant Limb in a Cray-fish," BIOL. BULL., Vol. VI., No. 2, January, '04) attempted to induce the development of monstrosities in the propodites of the chelate walking legs by making deep cuts in the adult limbs at the places where the new structures were expected to develop. Though 103 operations were made no positive results were obtained.